

Original articles

Changes in haemodynamic parameters following Tai Chi Chuan and aerobic exercise in patients recovering from acute myocardial infarction

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Summary

In this study, 126 patients (90 males, average age 56 years, range 39–80) were randomised to Wu Chian-Ch'uan style Tai Chi (38), aerobic exercise (41) or a non-exercise support group (47) following acute myocardial infarction. Patients attended twice weekly for three weeks then weekly for a further five weeks. Heart rate and blood pressure were recorded before and after each session. Over the 11 sessions of exercise there was a negative trend in diastolic blood pressure only in the Tai Chi group ($R_s=0.79$, $p<0.01$). Significant trends in systolic blood pressure occurred in both exercise groups ($R_s=0.64$ and 0.63 , both $p<0.05$). Only four (8%) patients completed the support group eight-week programme which was less than the number completing Tai Chi (82%; $p<0.001$) and aerobic exercise groups (73%; $p<0.001$).

Keywords: haemodynamics, Tai Chi Chuan, exercise, acute myocardial infarction

Many strategies have been developed to improve the prognosis of myocardial infarction. These range from public health campaigns to raise awareness and prompt early reporting of cardiac symptoms,¹ aggressive drug therapy interventions in the early post-infarct period aimed at limiting infarct size and preserving myocardium,² and cardiac rehabilitation aimed at reducing post-infarct mortality.³ Many drug therapies have been proven to reduce mortality including beta-blockers, aspirin, angiotensin-converting enzyme inhibitors, and warfarin.⁴

The psychological impact of myocardial infarction is great. Many patients lose confidence, and return to full time employment is slow and disappointingly infrequent at $<50\%$.⁵ Depressive illness is common and associated with a poor prognosis.⁶ Exercise cardiac rehabilitation has been shown in trials to improve well being and a meta-analysis has shown that it may reduce mortality by 20–25%.³ The only trials which have shown benefits have included exercise rehabilitation as a major component. However, elderly and infirm patients are often unable to exercise and many of the trials have been markedly selective in their recruitment because of this.

Tai Chi Chuan or shadow boxing is an ancient Chinese martial art which is used by millions of Chinese to maintain suppleness and mobility. It is suggested that it is well suited to elderly individuals because it requires only moderate work intensity; its steady rhythm linked with respiration is said to aid relaxation. In one study comparing the results of exercise testing of middle-aged sedentary individuals with that of Tai Chi practitioners, cardiovascular fitness was greater in the regular Tai Chi exercise group.⁷

In this parallel group trial we have randomised post-infarct patients to a cardiac support group, Tai Chi Chuan, or aerobic exercise classes, and studied the effect on haemodynamic variables.

Methods

The study was approved by the hospital ethics committee.

A total of 126 patients (90 males) of average age 56 years (range 39–80) participated in the trial. All had had definite acute myocardial infarction. All were capable of exercising and did not have severe arthritis, overt heart failure, or limiting angina.

Three weeks after discharge following acute myocardial infarction they were randomised to attend sessions of Tai Chi Chuan (38 patients), aerobic exercise (41 patients), or a cardiac support group (47 patients). Attendance was twice weekly for three weeks then weekly for a further five weeks. All groups received initial advice about risk factor modification. Participants in exercise classes were encouraged to continue the exercise programme at home.

Pulse and blood pressure were measured before and after exercise in both active groups and measured at the end of the cardiac support group after a period of 10 minutes of simple relaxation.

AEROBIC EXERCISE PROGRAMME

The exercise programme was based on an exercise-to-music format. All participants were assessed individually and alternative exercises (eg, at higher or lower energy levels) were prescribed when required. The exercise programme was divided into five major components, including periods for warm up, aerobic training, cool down, muscular strength and endurance stretch and relaxation.

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TAI CHI CHUAN

Tai Chi Chuan is a Chinese martial art which has become popular in China over the last 60–70 years. The movements are slow and require the muscles to remain as relaxed as possible whilst making a sustained even and continuous effort. The Wu Chian Chuan style (one of five original styles of Tai Chi) taught by the Ma family of Shanghai was used in this study.

Each session was of one hour duration with one five-minute break. The first half of each session was used for ‘Chi Kung’ exercises designed to relax the muscles of the shoulders, neck and back, allowing the body weight to be supported by the legs alone. Breathing is regulated by co-ordinating it with slow rhythmical movements of the arms and legs. Stillness in movement is very important in Tai Chi. It involves learning to keep the body completely still and relaxed whilst moving only that which is essential to execute the movement. Balance and concentration are important. The concept is that this concentrated effort combined with body stillness encourages a stillness of mind and of mood.

The second half of each session was spent learning the first part of the Wu Style short form. The short form is a series of 47 postures with specific transitional movements producing one sequential smooth continuous movement. This movement is executed slowly and quietly with the upper body in a poised yet relaxed posture. The body is balanced but one leg carries most of the body weight alternately from posture to posture. The arm and upper body movements are made with minimal muscle tension and are co-ordinated with the leg and body movements in continuous flowing patterns. Each sequence of movements was repeated several times, mostly with verbal directions and occasionally without.

Patients were asked to copy all movements and to try to remember the sequence. By the end of the trial, about one quarter (12 postures with transitional movements) of the short form of Tai Chi had been learnt. The instructor ensured that all participants were performing the movements correctly.

CARDIAC SUPPORT GROUP

Patients attended weekly sessions of one hour duration accompanied by their spouse. The group discussed practical issues of risk factor modification, and problems in rehabilitation. No formal exercise was performed during these sessions although advice on return to activities was given. Each session finished with 10 minutes of relaxation.

STATISTICAL METHODS

Non-parametric methods were used; Chi-square test and Rank Spearman correlation coefficient for trend over time were used as the time intervals were not equally spaced. A probability of <0.05 was considered statistically significant.

Results

HAEMODYNAMIC CHANGES

Both forms of exercise caused significant immediate falls in systolic and diastolic blood pressure and a significant increase in heart rate but aerobic exercise caused a much greater increase (table). Heart rate increased in *all* patients undergoing aerobic exercises but in 13 (34%) of the Tai Chi group heart rate was unchanged or decreased after exercise. ($\chi^2=14.4$, $p<0.001$).

TRENDS IN BLOOD PRESSURE

Over the 11 sessions of exercise there was a negative trend in diastolic blood pressure in the Tai Chi group ($R_s=-0.79$, $p<0.01$) but no trend was seen following aerobic exercise ($R_s=0.08$ $p=ns$, figures 1 & 2). Significant trends in systolic blood pressure occurred for both Tai Chi ($R_s=0.64$, $p<0.05$) and aerobic exercise ($R_s=0.63$, $p<0.05$, figures 3 & 4).

TRENDS IN HEART RATE

Tai Chi was associated with a negative trend in resting heart rate ($R_s=0.61$, $p<0.06$) but aerobic exercise showed no trend ($R_s=0.14$, $p>0.05$). Haemodynamic changes in the control group showed no significant trend but the numbers enrolled were fewer and the fall-out rate was high.

MOTIVATION

Only 4/47 (8%) patients completed the eight-week non-exercise programme which was significantly fewer than completed the Tai Chi (82%, $p<0.001$) and aerobic exercise (73%, $p<0.001$).

Discussion

Regular vigorous exercise has important cardiovascular effects. Exercise may be protective in that coronary events are reduced by regular exercise in a dose-related manner, although strenuous and unaccustomed physical exercise may be disadvantageous.⁸ In patients with cardiac disease, regular exercise has been shown to ameliorate symptoms.⁹ In patients recovering from acute myocardial infarction exercise has been shown by meta-analytical techniques to reduce subsequent cardiovascular mortality from sudden death and fatal reinfarction.³ However, exercise cannot be performed by all patients, especially those with marked left ventricular impairment, and most trials have included only young patients.

Table Changes in haemodynamic parameters immediately after exercise

Parameter	Aerobic exercise (mean (SD))	T'ai Chi exercise (mean (SD))
Heart rate (beats/min)	+11 (7.3)	+2 (3.2)*
Systolic BP (mmHg)	-4 (7.5)	-3 (3.3)
Diastolic BP (mmHg)	-1 (3.7)	-2 (2.7)

* $p<0.001$; BP, blood pressure; SD, standard deviation

Figure 1 The trend ($R_s=0.79$, $p<0.01$) in mean diastolic blood pressure associated with Tai Chi exercise

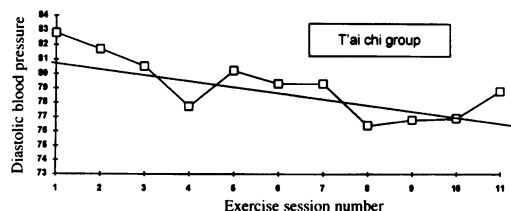


Figure 2 The trend ($R_s=0.08$, $p=ns$) in mean diastolic blood pressure associated with aerobic exercise

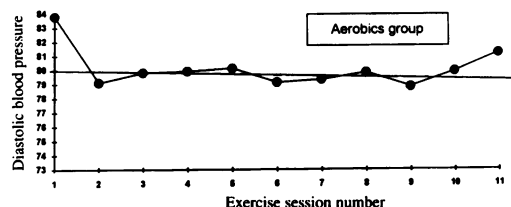


Figure 3 The trend ($R_s=0.64$, $p<0.05$) in systolic blood pressure associated with Tai Chi exercise

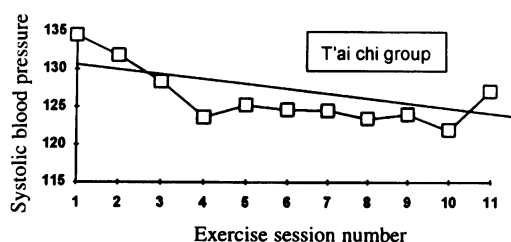
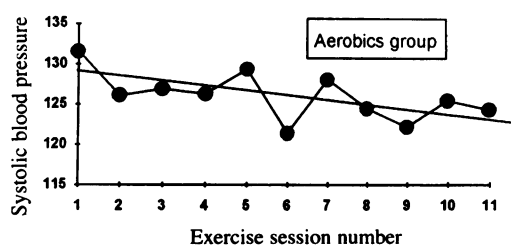


Figure 4 The trend ($R_s=0.63$, $p<0.05$) in systolic blood pressure associated with aerobic exercise



Light exercise programmes are of benefit in improving exercise tolerance in the recovery period after myocardial infarction.¹⁰ Tai Chi

Learning points

- both aerobic exercise and Tai Chi are associated with falls in systolic blood pressure in the recovery period after myocardial infarction
- Tai Chi was also associated with a fall in diastolic blood pressure
- attendance at post-infarction rehabilitation classes was enhanced if structured exercise was included
- Tai Chi offers an alternative form of exercise in this setting

only requires slow sustained movements and although it has been shown to be associated with increases in heart rate,⁷ in our study heart rate increases were small.

The mechanisms by which exercise may improve cardiovascular risk are not fully understood, but reductions in blood pressure may play a role. We demonstrated that blood pressure fell in both exercise and Tai Chi groups. Unfortunately we were unable to establish that these reductions were related to exercise since our control group data was limited because of the very high drop out rate. Attendance at rehabilitation exercise classes is not good; in Goble's study¹⁰ only 41% of patients attended more than 75% of their light exercise classes, although 65% attended more than 75% of exercise training classes. In our study, attendance at cardiac rehabilitation sessions was better if it included exercise of either type; this may reflect the perceived benefit of exercise by patients.

In conclusion, this study shows that regular Tai Chi or aerobic exercise in the recovery period from acute myocardial infarction is associated with falls in blood pressure. Tai Chi may be a useful alternative to formal aerobic exercise as part of a cardiac rehabilitation programme, and was readily accepted by our patients.

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